

WHAT IS CLAIMED IS:

1. A deposited-film formation method comprising the steps of: providing a discharge electrode in a vacuum vessel equipped with exhaust means; supplying a hydrogen gas and a raw material gas for forming a deposited film which contains at least an Si element; generating plasma from the material gas by supplying high frequency electric power to the discharge electrode; and forming a deposited film on a substrate in the vacuum vessel by plasma CVD,

wherein an auxiliary electrode is arranged in plasma in the vacuum vessel, and a periodically changing voltage is applied to the auxiliary electrode without causing a discharge to form a deposited film.

2. The deposited-film formation method according to claim 1, wherein a voltage applied to the auxiliary electrode has a maximum amplitude of 80 V or less.

3. The deposited-film formation method according to claim 2, wherein the maximum amplitude of the voltage is 20 V to 80 V.

4. The deposited-film formation method according to claim 2, wherein the maximum amplitude of the voltage is 20 V to 60 V.

5. The deposited-film formation method according to claim 1, wherein when the periodically changing voltage is applied to the auxiliary electrode, a voltage lower than the potential of plasma from the material gas is applied only in a certain period in at least one cycle of the periodically changing voltage.

6. The deposited-film formation method according to claim 1, wherein the plural auxiliary electrodes are arranged at least in a flow direction of the material gas.

7. The deposited-film formation method according to claim 1, wherein a frequency of the high frequency electric power supplied to the discharge electrode is 10 kHz to 500 MHz.

8. The deposited-film formation method according to claim 1, wherein a frequency of the high frequency electric power applied to the auxiliary electrode is equal to or higher than 100 kHz.

9. The deposited-film formation method according to claim 1, wherein the auxiliary electrode is formed from an edgeless and small electrode having a small area facing a substrate in the vacuum vessel.

10. The deposited-film formation method according to claim 1, wherein the auxiliary electrode is formed from a round bar which has a small diameter and which is made of a high strength material of a high melting metal.

11. A deposited-film formation method comprising the steps of: providing a discharge electrode in a vacuum vessel equipped with exhaust means; supplying a hydrogen gas and a raw material gas for forming a deposited film which contains at least an Si element; generating plasma from the material gas by supplying high frequency electric power to the discharge electrode; and forming a deposited film on a substrate in the vacuum vessel by plasma CVD,

wherein an auxiliary electrode is arranged in plasma in the vacuum vessel, a periodically changing voltage is applied to the auxiliary electrode so that a voltage lower than the potential of plasma from the material gas is applied only in a certain period in at least one cycle of the periodically changing voltage, thereby forming a deposited-film.

12. A deposited-film formation method comprising the steps of: providing a discharge electrode in a vacuum vessel equipped with exhaust means; supplying a hydrogen gas and a raw material gas for forming a

deposited film which contains at least an Si element;  
generating plasma from the material gas by supplying  
high frequency electric power to the discharge  
electrode; and forming a deposited film on a substrate  
5 in the vacuum vessel by plasma CVD,

wherein an auxiliary electrode is arranged in  
plasma in the vacuum vessel, a high-frequency power of  
10 kHz to 500 MHz is applied to the discharge  
electrode, and a high-frequency power of 100 KHz or  
10 higher to the auxiliary electrode, thereby forming a  
deposited-film.

13. A deposited-film formation method comprising  
the steps of: providing a discharge electrode in a  
15 vacuum vessel equipped with exhaust means; supplying a  
hydrogen gas and a raw material gas for forming a  
deposited film which contains at least an Si element;  
generating plasma from the material gas by supplying  
high frequency electric power to the discharge  
20 electrode; and forming a deposited film on a substrate  
in the vacuum vessel by plasma CVD,

wherein an auxiliary electrode is arranged in  
plasma in the vacuum vessel, a periodic electric field  
is applied to the auxiliary electrode, and only  
25 electrons are energized without energizing ions to  
discompose a hydrogen gas and generate hydrogen  
radicals, thereby forming a deposited film.

14. A deposited-film formation apparatus for forming a deposited film on a substrate in the vacuum vessel by plasma CVD, comprising: a vacuum vessel equipped with exhaust means; raw material gas supply means for supplying a raw material gas for forming a film and a discharge electrode for making plasma from the material gas which are provided in the vacuum vessel; and electric-power introduction means for applying high-frequency electric power from a high frequency power source to the discharge electrode,

wherein an auxiliary electrode is arranged between the substrate in the vacuum vessel and the discharge electrode provided with facing the substrate, and voltage application means is provided which enables application of a periodically changing voltage without causing a discharge.

15. The deposited-film formation apparatus according to claim 14, wherein the voltage application means applying a voltage to the auxiliary electrode is configured so as to apply a voltage having a maximum amplitude of 80 V or less.

16. The deposited-film formation apparatus according to claim 15, wherein the voltage application means is configured so as to apply a voltage having a maximum amplitude of 20 V to 80 V.

17. The deposited-film formation apparatus according to claim 15, wherein the voltage application means is configured so as to apply a voltage having a maximum amplitude of 20 V to 60 V.

5

18. The deposited-film formation apparatus according to claim 14, wherein the voltage application means applying a voltage to the auxiliary electrode is configured so as to apply a voltage lower than potential of plasma from the material gas only in a certain period in at least one cycle of the periodically changing voltage.

10

19. The deposited-film formation apparatus according to claim 14, wherein a plurality of auxiliary electrodes are arranged at least in a flow direction of the material gas.

15

20. The deposited-film formation apparatus according to claim 14, wherein the high frequency power source supplies a high frequency electric power having a frequency of 10 KHz to 500 MHz to the discharge electrode.

20

21. The deposited-film formation apparatus according to claim 14, wherein the voltage application means applying a voltage to the auxiliary electrode is

25

20250409 09:34:00

configured so as to apply a high frequency electric power having a frequency of 100 KHz or higher.

22. The deposited-film formation apparatus  
5 according to claim 14, wherein the auxiliary electrode is formed from an edgeless and small electrode having a small area facing a substrate in the vacuum vessel.

23. The deposited-film formation apparatus  
10 according to claim 14, wherein the auxiliary electrode is formed from a round bar having a small diameter which is made of a high strength material of a high melting metal.

24. A deposited-film formation apparatus for  
15 forming a deposited film on a substrate in this vacuum vessel by plasma CVD, comprising: a vacuum vessel equipped with exhaust means; raw material gas supply means for supplying a raw material gas for forming a  
20 film and a discharge electrode for making plasma from the material gas which are provided in the vacuum vessel; and electric-power introduction means for applying high-frequency electric power from a high frequency power source to the discharge electrode,  
25 wherein an auxiliary electrode is arranged between a substrate in the vacuum vessel and the discharge electrode provided with facing the substrate, wherein

voltage application means is provided which enables application of a periodically changing voltage without causing a discharge, and wherein the voltage application means applying a voltage to the auxiliary electrode applies a periodically changing voltage to the auxiliary electrode so that a voltage lower than potential of plasma from the material gas is applied only in a certain period in at least one cycle of the periodically changing voltage.

10

25. A deposited-film formation apparatus for forming a deposited film on a substrate in the vacuum vessel by plasma CVD, comprising: a vacuum vessel equipped with exhaust means; raw material gas supply means for supplying a raw material gas for forming a film and a discharge electrode for making plasma from the material gas which are provided in the vacuum vessel; and electric power introduction means for applying high-frequency electric power from a high frequency power source to the discharge electrode,

20

wherein an auxiliary electrode is arranged between a substrate in the vacuum vessel and the discharge electrode provided with facing the substrate, wherein voltage application means is provided which enables application of a periodically changing voltage without causing a discharge, wherein the high-frequency power source is provided for supplying a high-frequency

25

09843640-032304  
10000-040000



electric power of 10 KHz to 500 MHz to the discharge  
electrode, and wherein voltage application means  
applying a voltage to the auxiliary electrode is  
configured so as to apply a high frequency electric  
5 power having a frequency of 100 KHz or higher.

26. A deposited-film formation apparatus for  
forming a deposited film on a substrate in this vacuum  
vessel by plasma CVD, comprising: a vacuum vessel  
10 equipped with exhaust means; raw material gas supply  
means for supplying a raw material gas for forming a  
film and a discharge electrode for making plasma from  
the material gas which are provided in the vacuum  
vessel; and electric-power introduction means for  
15 applying high-frequency electric power from a high  
frequency power source to the discharge electrode,

wherein an auxiliary electrode is arranged between  
a substrate in the vacuum vessel and the discharge  
electrode provided with facing the substrate, wherein  
20 electric field application means is provided for  
energizing only electrons without energizing ions,  
discomposing a hydrogen gas, generating hydrogen  
radicals to form a deposited film by applying a  
periodic electric field to the auxiliary electrode.

25

09818540-032801